



Spatial Data Analysis and Visualization with ArcGIS

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Spatial Data Lab Webinar

Effective Data Management and Spatial Analytics

June 22, 2021

ArcGIS is a Powerful and Comprehensive System for Spatial Analysis and Data Science



Data
Engineering



Visualization
& Exploration



Spatial
Analysis



Machine Learning
& AI



Big Data
Analytics



Modeling
& Scripting



Sharing
& Collaboration

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Modeling
& Scripting

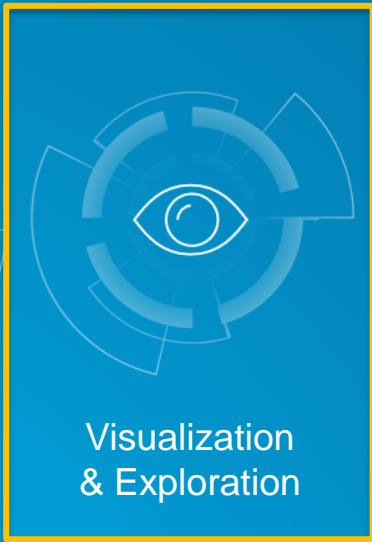


Sharing
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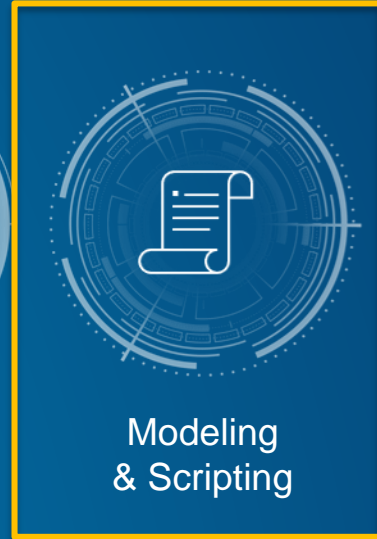
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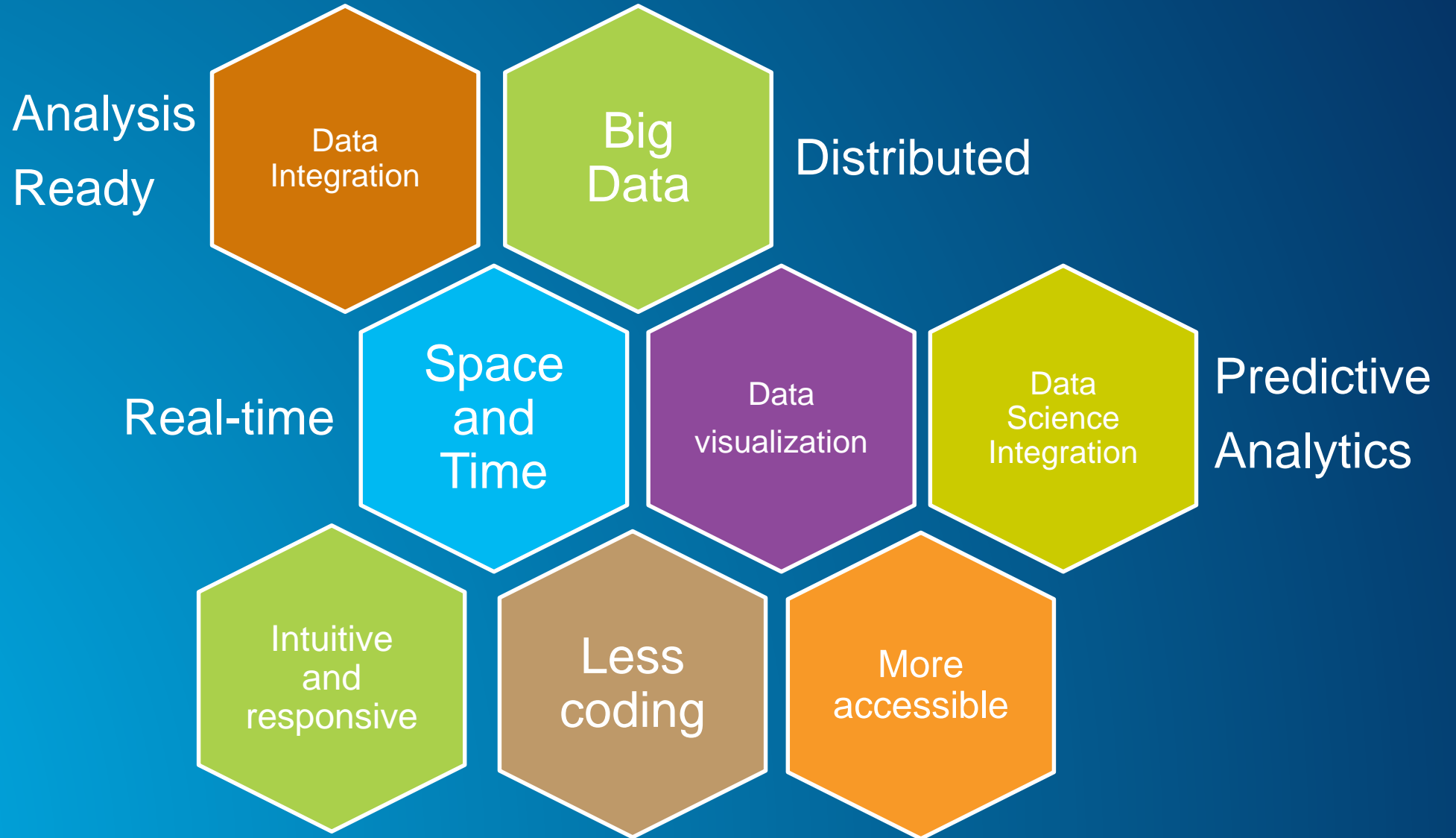
Modeling
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Spatial Analysis

Directions

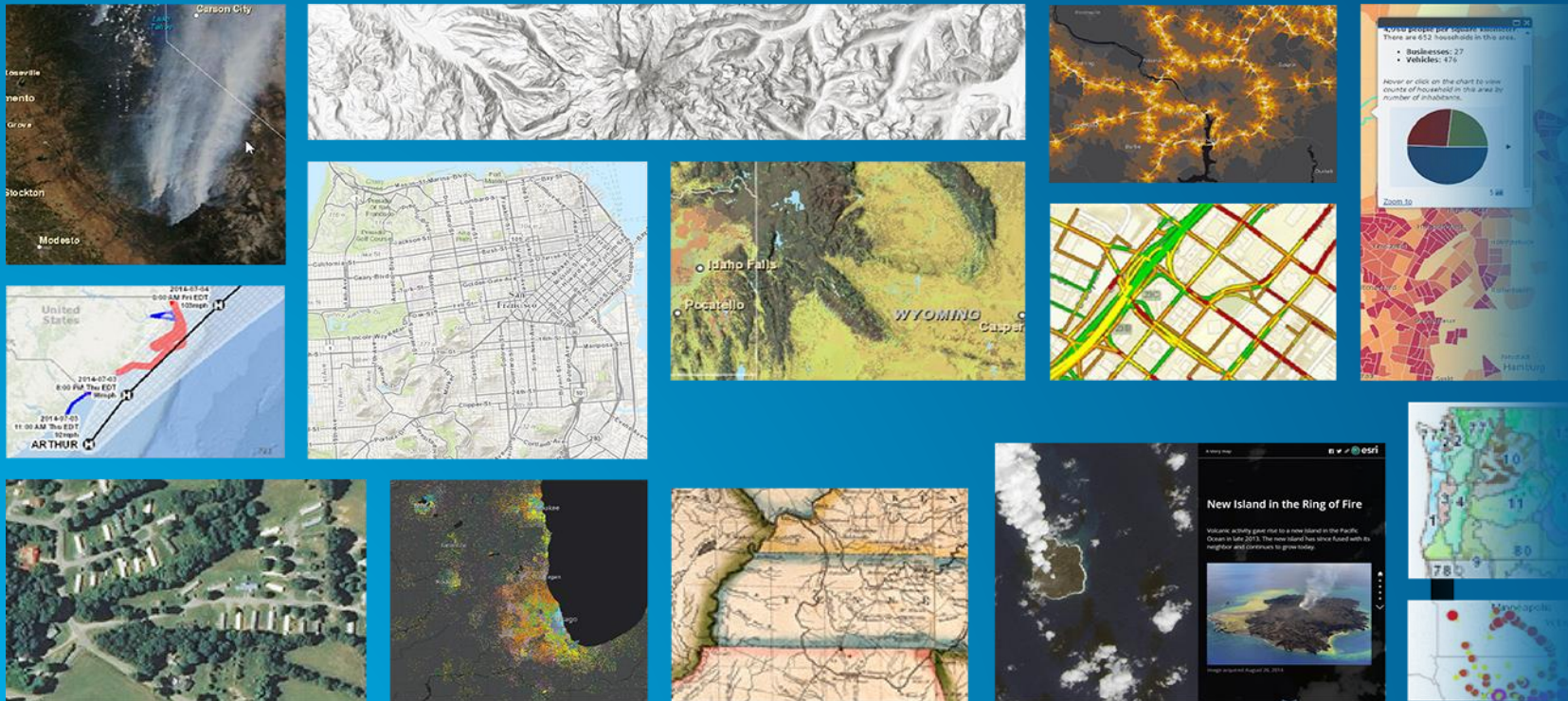


Data Integration

Analysis is only as good as the data

ArcGIS includes ready-to-use content

Maps, apps, layers, and more from Esri and the global GIS community - a Living Atlas



Trending
POI
Transportation
Environment
Observations
Landscape
Infrastructure
Basemaps
Boundaries
Land Cover
Oceans
Historical
Imagery
Weather
People
Demographics
Places
Business
Habitats
Elevation
Traffic
Movement
Hazards
Hydro
Layers

... curated, authoritative content with continuous updates

ArcGIS GeoEnrichment

- Connect your existing data with Esri's authoritative datasets
- Esri-hosted location service powered by advanced spatial analytics and global business and demographic data
- Over 15,000 data variables from more than 130 countries

Data Browser

Search for a variable name

United States

All Data

Population Income Age Households Housing

Health Education Business Race Spending

Behaviors Jobs Poverty Marital Status Tapestry

APPLY CANCEL

Enrichment - Enriched Location Around SF Peninsula - ArcGIS Pro

Geoprocessing

Enrich Layer

Parameters | Environments

Input Features: BlockGroups_bg_gen7

Output Feature Class: BGs_Healthcare_Spending

Variables: Health Care

Add Variable

USA_ESBI_2018

Categories

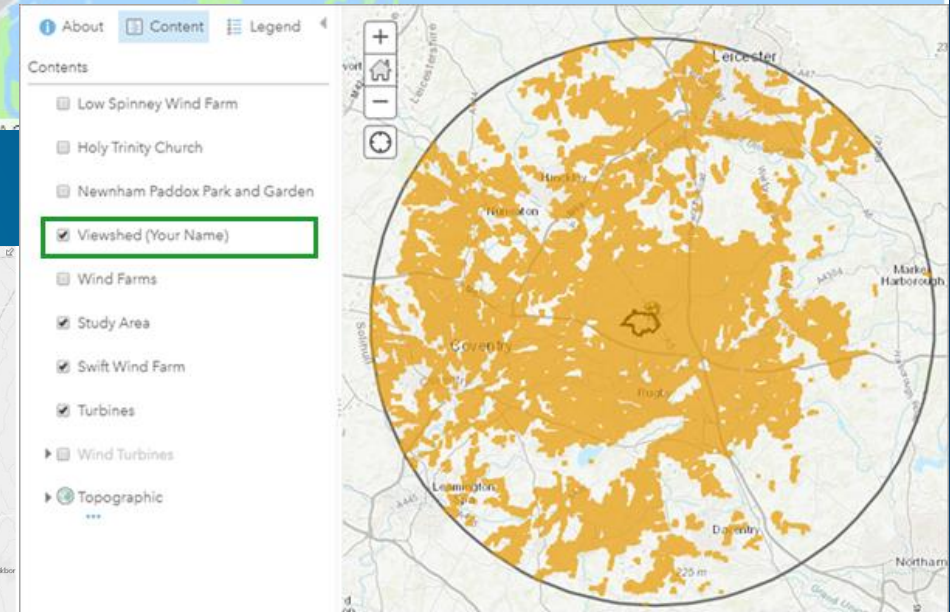
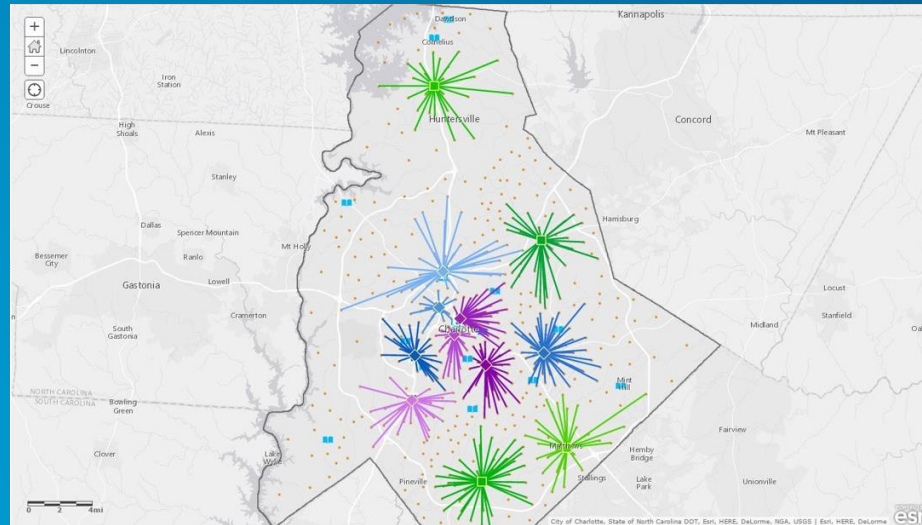
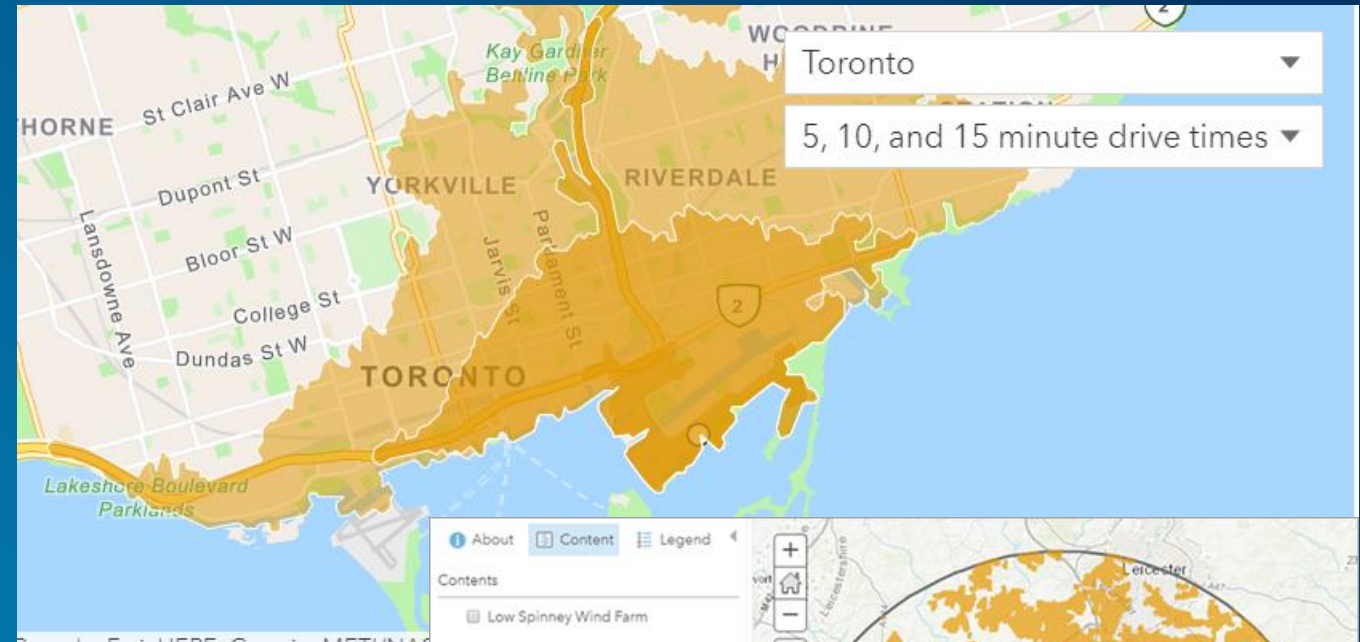
Custom Data

Population Income Age Household

Location	2019 Average Household Income	2014-2018 ACS HHs: Inc Below Poverty Level	2014-2018 ACS Owner HHs by Vehicles Avail: 0	2014-2018 ACS Owner HHs by Vehicles Avail: 0: Percent	2019 Education: Associate's Degree: Percent	2019 Education: Bachelor's Degree: Percent
322	161899	1109	592	13.34	6.04	3.77
770	117431	7088	1298	25.7	12.13	3.25
330	172094	2252	612	9.03	8.69	6.2
992	159929	468	515	11	5.54	3.56
586	161643	364	398	16.15	9.74	3.42
305	115116	570	396	17.15	12.01	6.82
387	229633	410	151	6.61	5.53	4.38
737	151170	2481	708	9.93	26.08	4.12
382	226757	577	529	6.22	14.54	4.46
331	136190	689	341	12.01	6.82	4.12
338	133217	465	292	6.61	5.53	4.38
989	232746	130	206	5.53	4.38	3.25
777	165197	741	439	9.93	26.08	4.12
324	116494	2754	494	12.01	6.82	4.12
381	249152	248	159	6.22	14.54	4.46
172	173285	929	447	14.54	4.46	3.25

Ready-to-use Services

- Combines analysis services with authoritative content
 - Geocoding
 - Drive time areas
 - Location Allocation
 - Vehicle Routing Problem (VRP) Solver
 - Elevation
 - Hydrology



Quickly generate a drive time or watershed area without having to collect, maintain, or update data on local

Data Engineering **new in ArcGIS Pro**

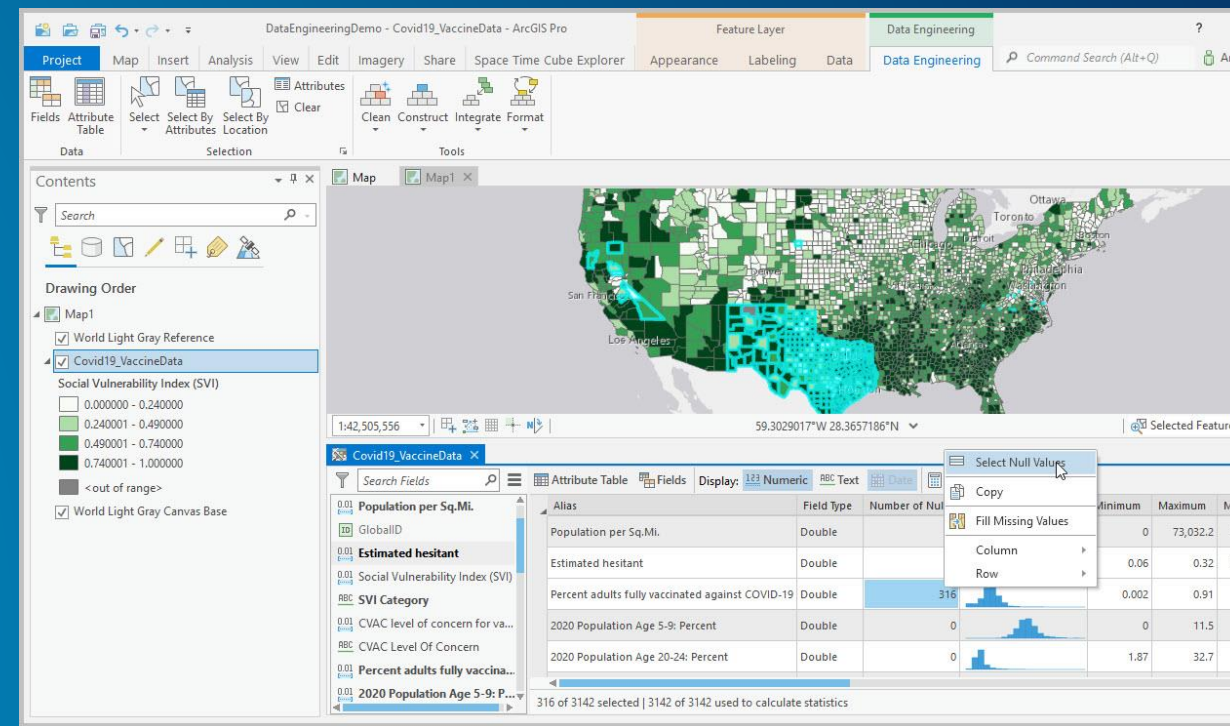
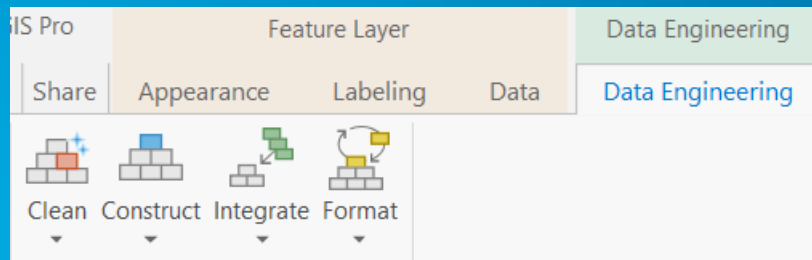
A new, unified experience to interactively prepare data for analysis

Quickly evaluate data quality and fix common problems

Explore data distribution and categories by quick configuring maps and viewing charts



A curated set of geoprocessing tools to clean, construct, integrate, and format your data

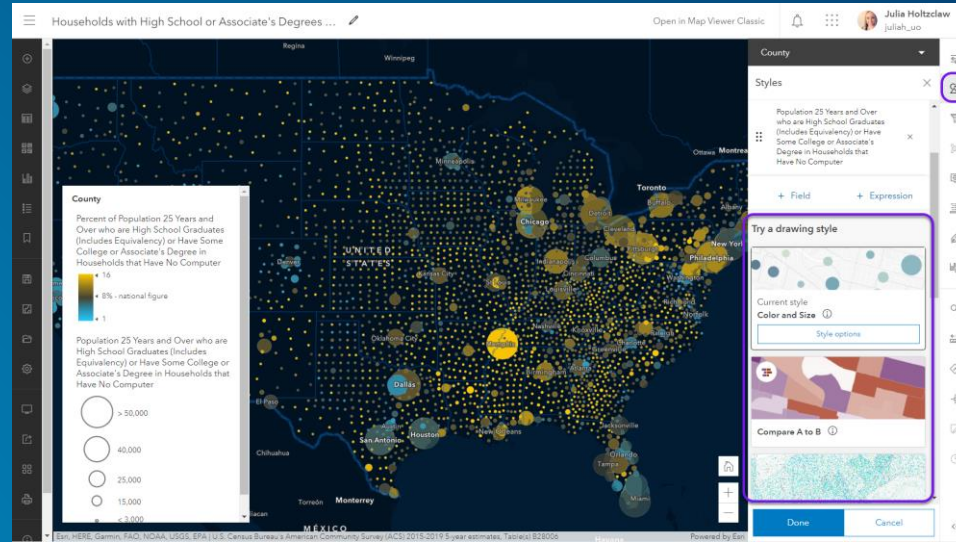


Visualization & Exploration

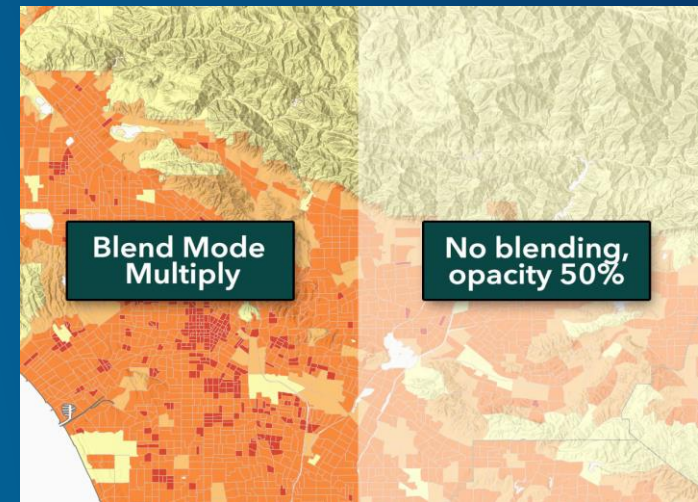
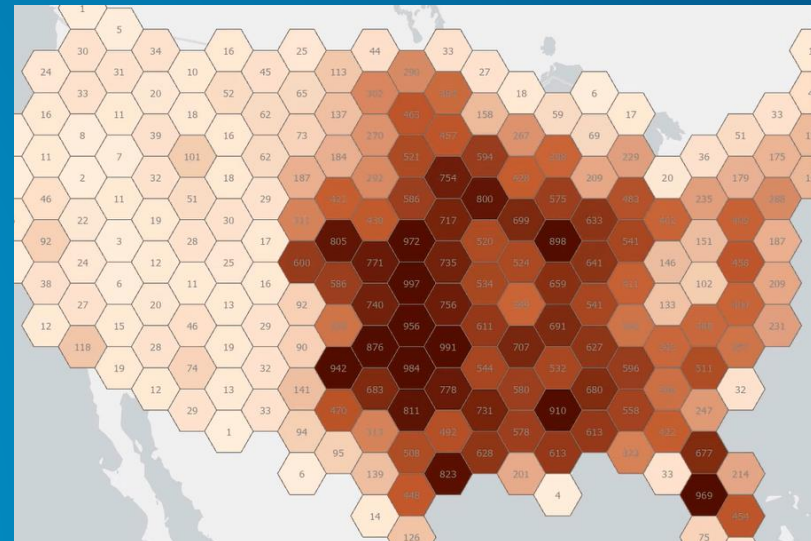
Make sense of your data

Mapping

- Mapping is at the heart of ArcGIS
- New map viewer in ArcGIS Online with interactive smart mapping
- Many mapping enhancements made in ArcGIS Pro
 - Voxel layers support
 - Dynamic feature binning
 - Feature and layer blending
 - Graphics layers
 - Projection improvements

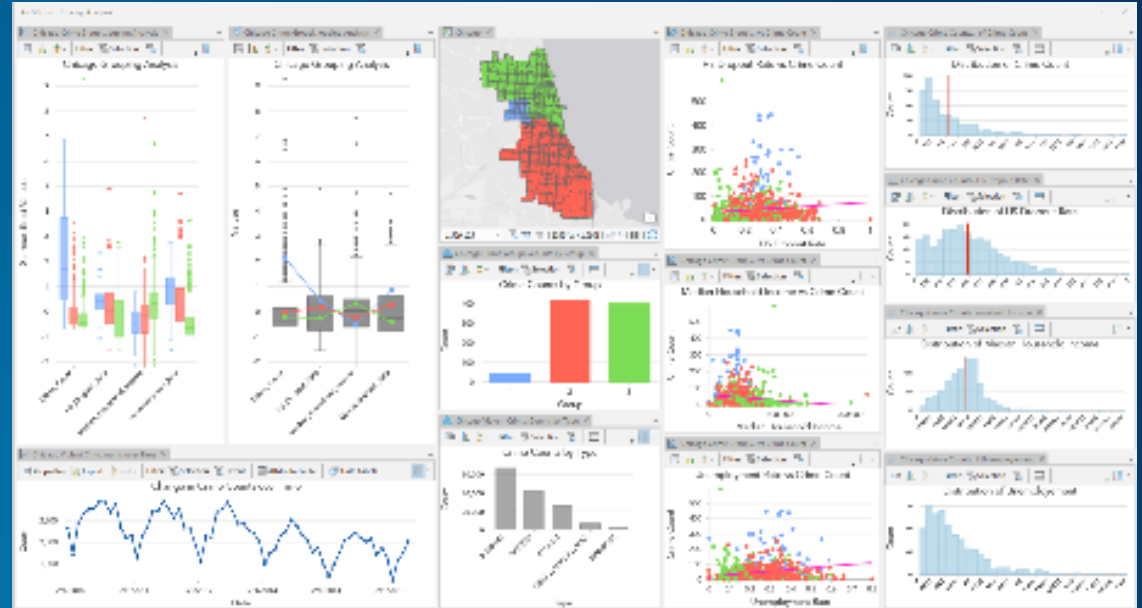


New Map Viewer in ArcGIS Online

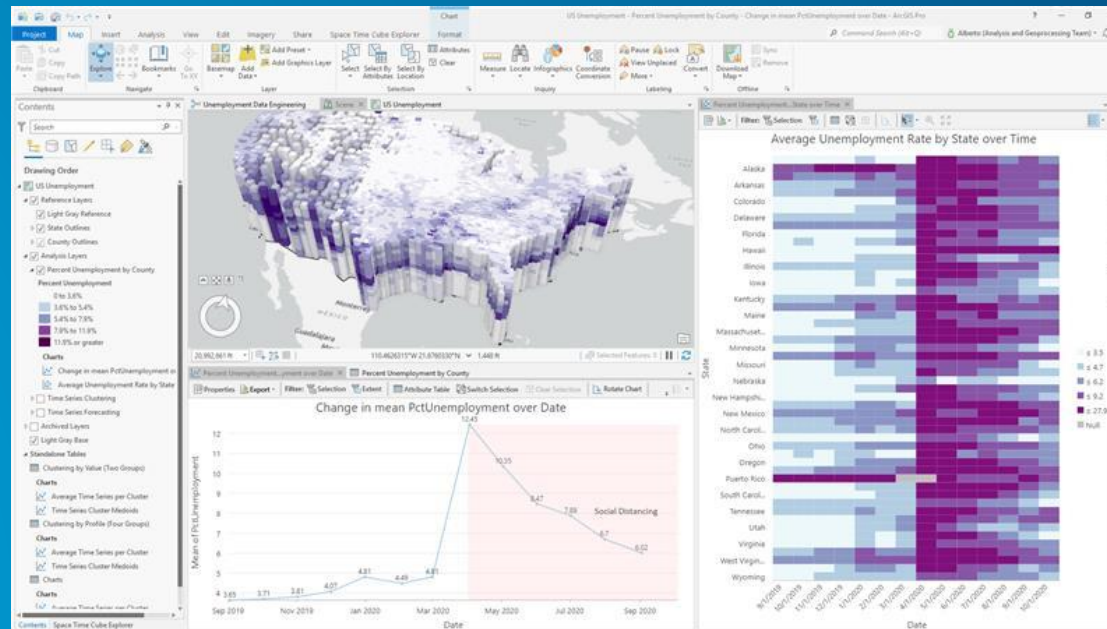


Charts

- Visualize and explore data to assess patterns and trend
- Part of analysis output
- Charts are now available in ArcGIS Online
- Same charting experience across the ArcGIS Platform



New in ArcGIS
Charts in ArcGIS Online



Advancing Spatial Science

The heart of spatial analysis

Advancing Spatial Science



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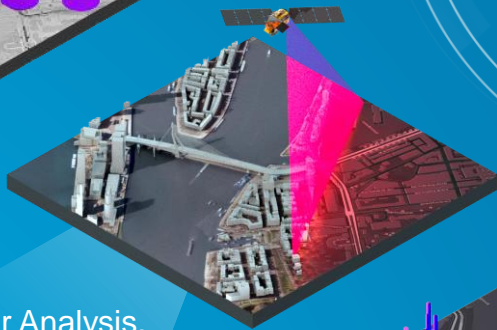
Advancing Spatial Science



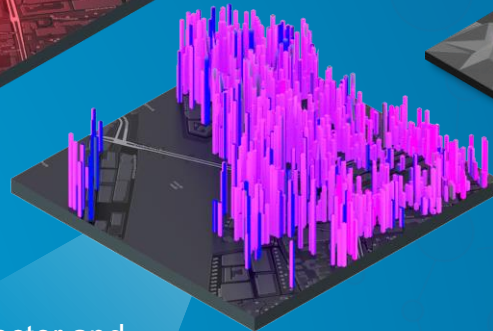
AI, Machine Learning, Deep Learning



Raster Analysis, Deep Learning



Big Vector and Tabular Data Analysis



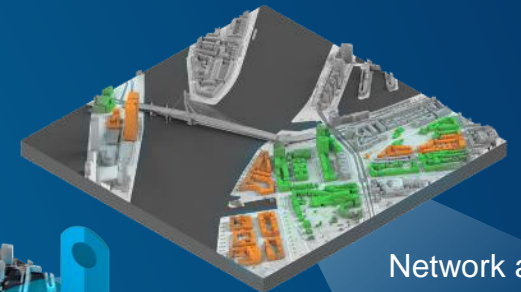
Real-Time Analysis



Vector and Tabular Analysis, Spatial Statistics



Network and Routing Analysis

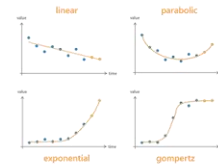


Focused on finding the right tools to solve your problem

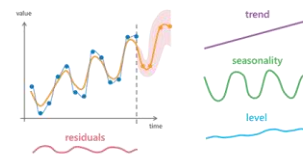
Spatial Statistics

- Many new capabilities focusing on spatial machine learning
 - Clustering
 - Classification
 - Regression
 - Time-series forecasting **New**

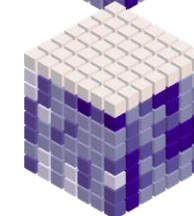
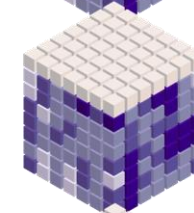
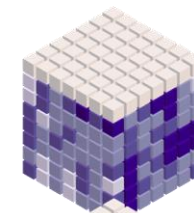
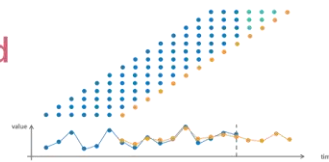
Curve Fit Forecast



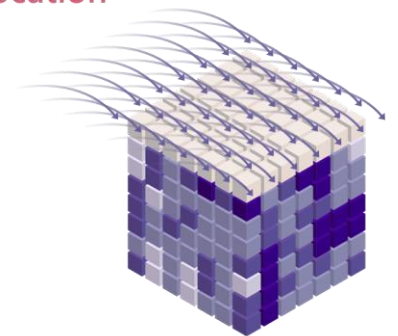
Exponential Smoothing Forecast



Forest-based Forecast



Evaluate
Forecasts by
Location

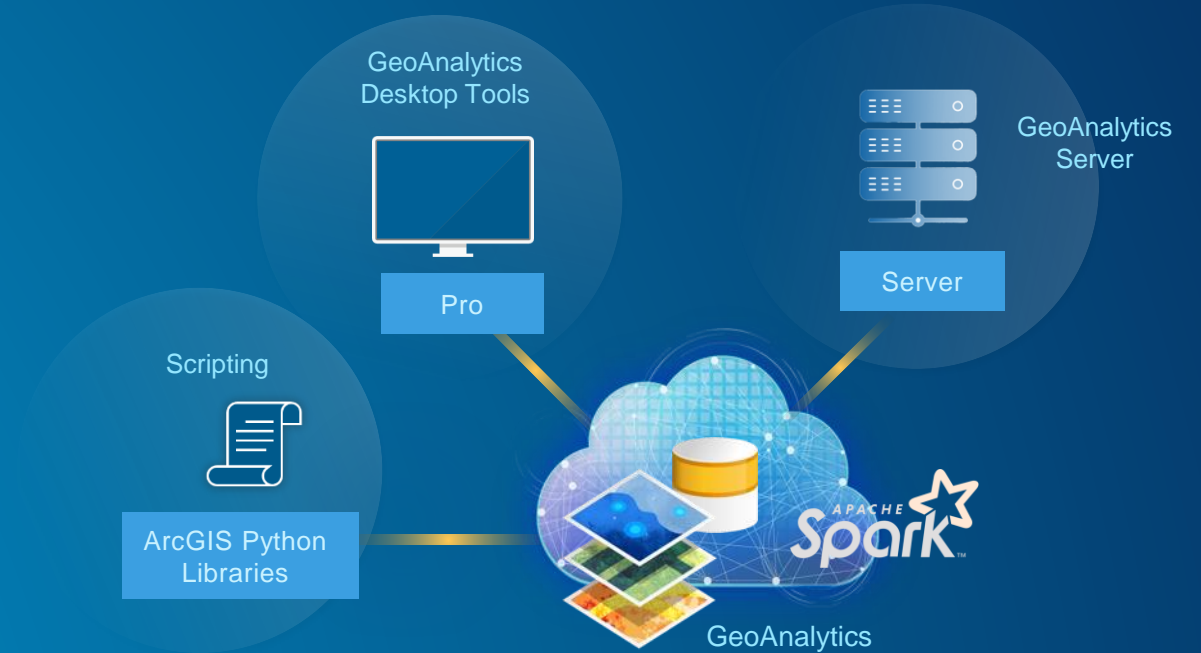


Big Data Analytics

- Analytics and Data Engineering for Spatial Big Data – GeoAnalytics
- Leverage Spark technology to distribute data and analysis

New

- Big Data Connection Wizard in ArcGIS Pro
 - Treats many individual files as a single big input



Leveraging and Analyzing Real-Time Data

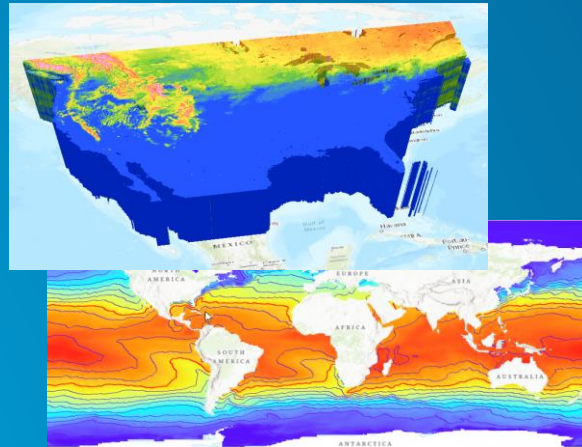
- **Ingest real-time sensor data**
- **Analyze data to detect incidents**
 - In real-time
 - In *near* real-time
 - Over time (GeoAnalytics tools)
- **Send alerts and take action**

New in ArcGIS



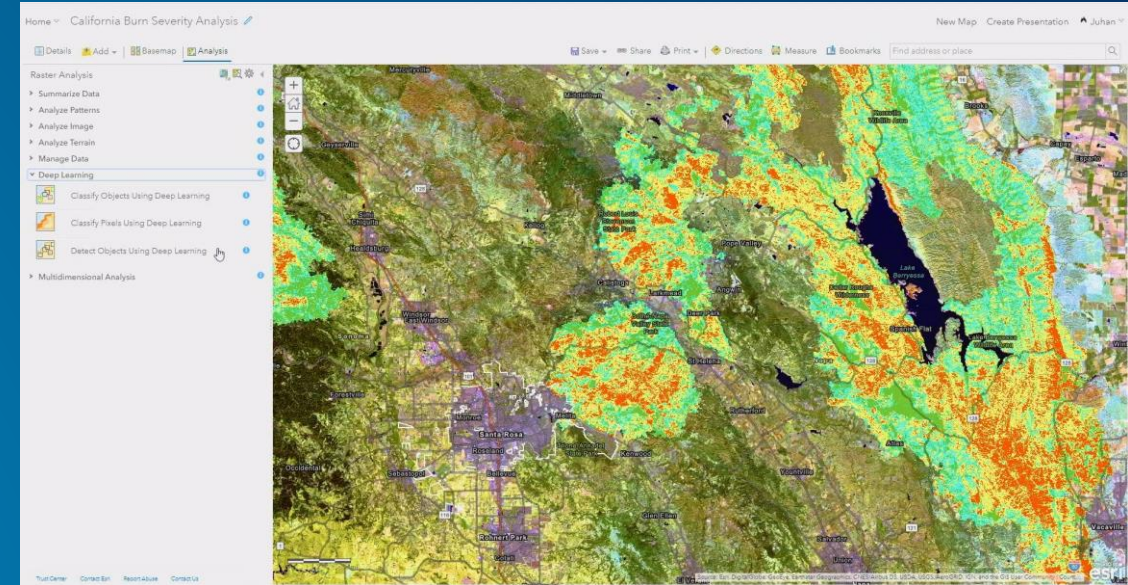
Imagery/Raster Analysis

- Terrain Analysis
- Suitability Modeling
- Map Algebra
- Hydrological Modeling
- Distance Modeling
- Multidimensional Analysis
- Change Detection
- Image Classification
- Machine Learning
- Deep Learning



New in ArcGIS

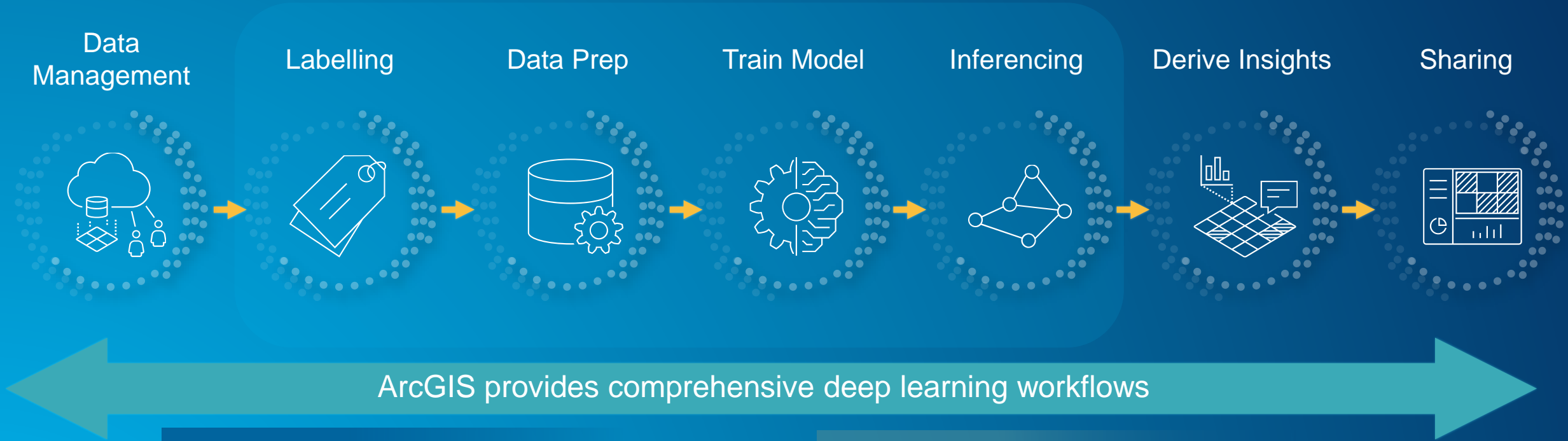
ArcGIS Image for ArcGIS Online



Leverage the imagery and raster data in your organization without having to maintain the infrastructure to manage, serve and analyze

- 150 + raster functions
- 27 Ready-to-use tools
- Deep learning tools
- Raster function editor
- Server and Client-side processing

Deep Learning in ArcGIS



For Wide Range of Data Types

- Aerial
- Satellite
- Radar
- Text
- Lidar
- Features
- Motion Imagery
- Bathymetry
- Point Cloud
- Drone

Implementing Many Tasks

- Object Classification
- Object Detection
- Pixel Classification
- Image Translation
- Object Tracking
- Scanned Maps
- Feature processing
- Unstructured text processing

Pre-trained geospatial deep learning models

- Ready-to-use geospatial AI models
- Have been trained on data from a variety of geographies
- Available from ArcGIS Living Atlas

Eliminates:

- *Imagery requirements for model training*
- *Labelling requirements*
- *Training AI models*
- *Massive compute requirements*

The screenshot shows the ArcGIS Living Atlas of the World search results page for the query "deep learning". The page features a navigation bar with "Home", "Browse", "Apps", "Blog", "Contribute", "My Contributions", and "My Favorites". Below the search bar, there are filters for "All content types", "All time", "All regions", and "Sort by: Relevance". The search results are displayed in a grid of eight items, each with a thumbnail image and a title. The items are:

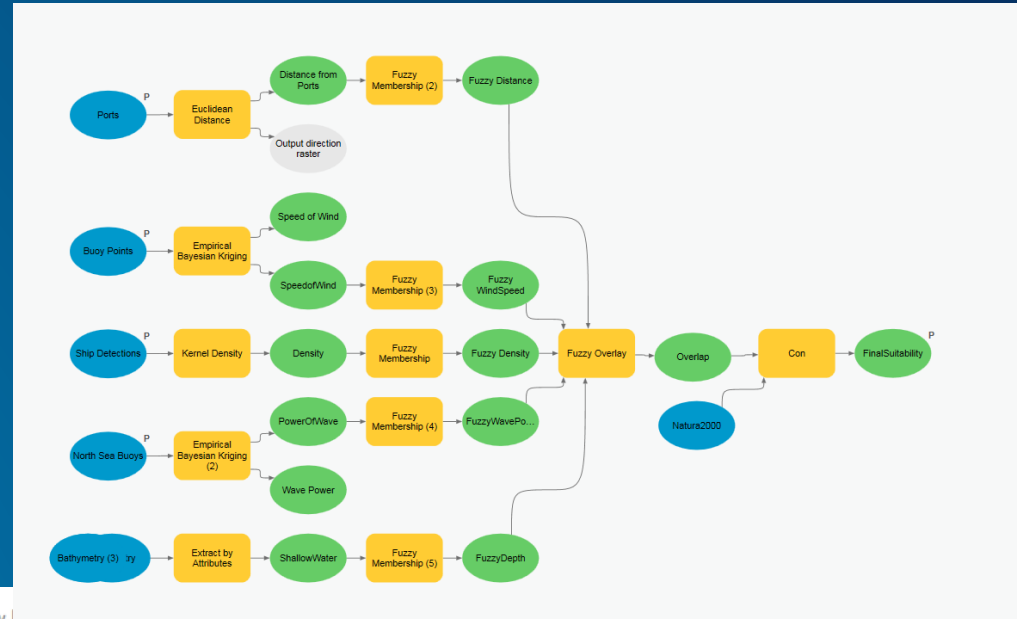
- Building Footprint Extraction - USA
- Land Cover Classification (Sentinel-2)
- Tree Point Classification
- Land Cover Classification (Landsat 8)
- Windows and Doors Extraction
- Shipwreck Detection
- Power Line Classification
- Road Extraction - North America

Modeling & Scripting

Automate and extend functionality

ModelBuilder, ArcPy & ArcGIS Notebooks

- Use ModelBuilder or Python to automate geoprocessing workflows or extend functionality
- ArcGIS Pro has ArcMap equivalency and many new capabilities
- ArcGIS Notebooks combine ArcGIS spatial algorithms (ArcPy, ArcGIS API for Python) with open-source Python libraries



New ArcGIS Notebooks

```
In [59]: # Remove existing layer of restaurant hot spots (if one exists)
gis.content.delete_items(
    gis.content.search(f'restaurant_hotspots_01 owner:{me.username}'))

# Run optimized hot spots, using sales volume as the analysis field
restaurant_hot_spots_item = features.analyze_patterns.find_hot_spots(
    restaurants_item, analysis_field='salesvol',
    output_name='restaurant_hotspots_01', gis=gis)

In [67]: # Create a map of Pittsburgh to show hot spot outputs
hot_spots_map = gis.map("Pittsburgh")
hot_spots_map.add_layer(restaurant_hot_spots_item)
hot_spots_map.zoom = 10
hot_spots_map

Out[67]:
```

R-ArcGIS Bridge

Combine ArcGIS mapping and spatial data processing with R statistical computing

Pass data between ArcGIS Pro and R dynamically

Now supports hosted GIS data and remote services including Living Atlas

Integrate R scripts into ArcGIS Geoprocessing tools and run ArcPy geoprocessing tools from R

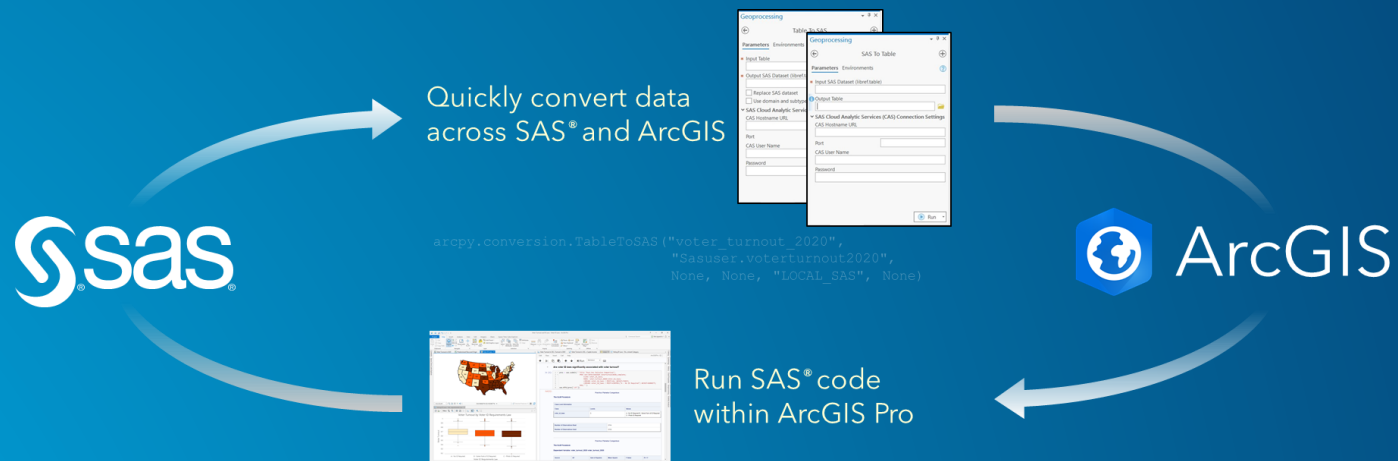
Create interactive web maps in R notebooks



SAS-ArcGIS Bridge **new in ArcGIS Pro**

Quickly convert data across SAS and ArcGIS

Use SAS analysis procedures directly within ArcGIS Pro



New

- SAS to Table tool
- Table to SAS tool
- SAS Python API integration

Sharing and Collaboration

The power of working together

Share Analysis

Many ways to share your geoprocessing and analysis work

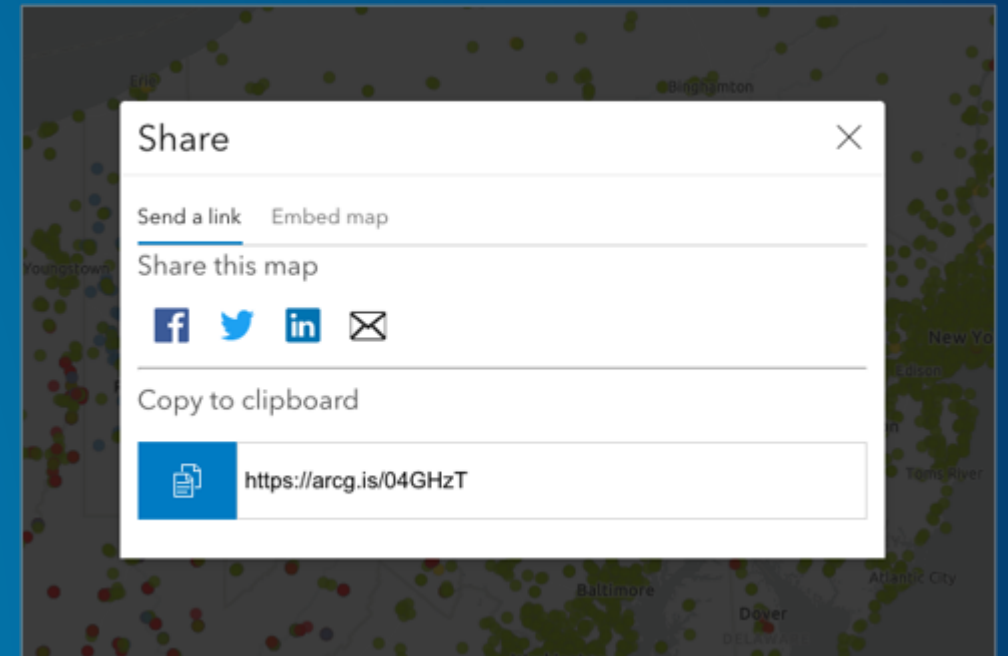
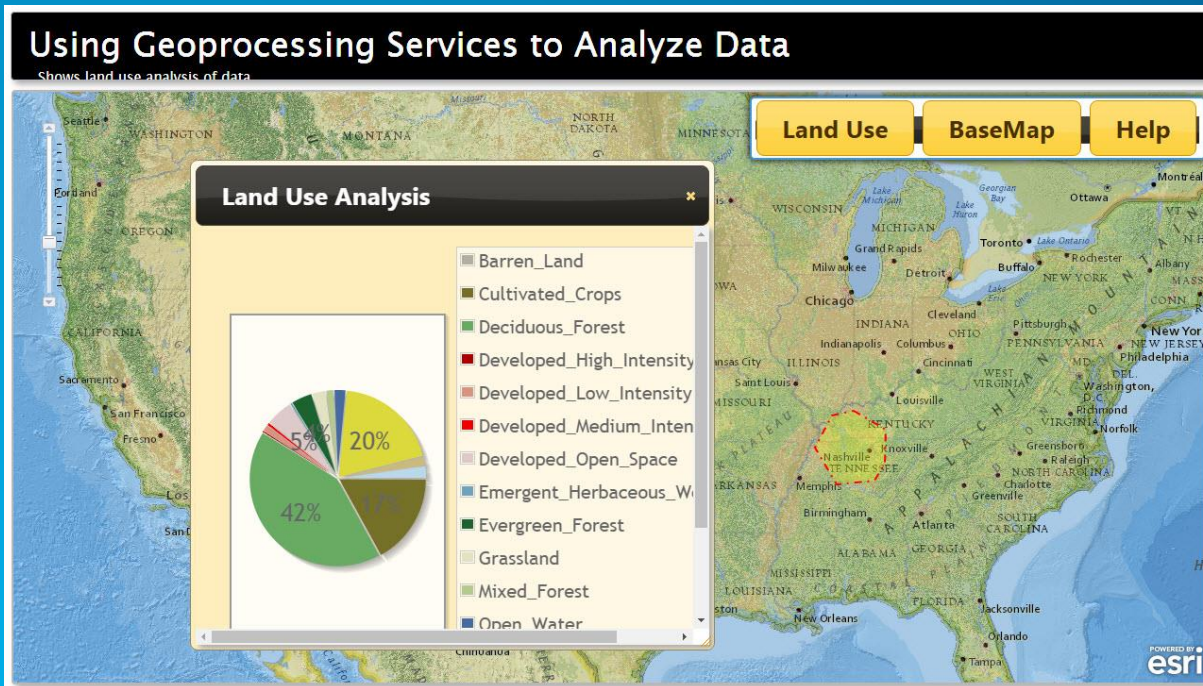
Geoprocessing Package

Web Tool/Geoprocessing Service

ArcGIS Notebooks

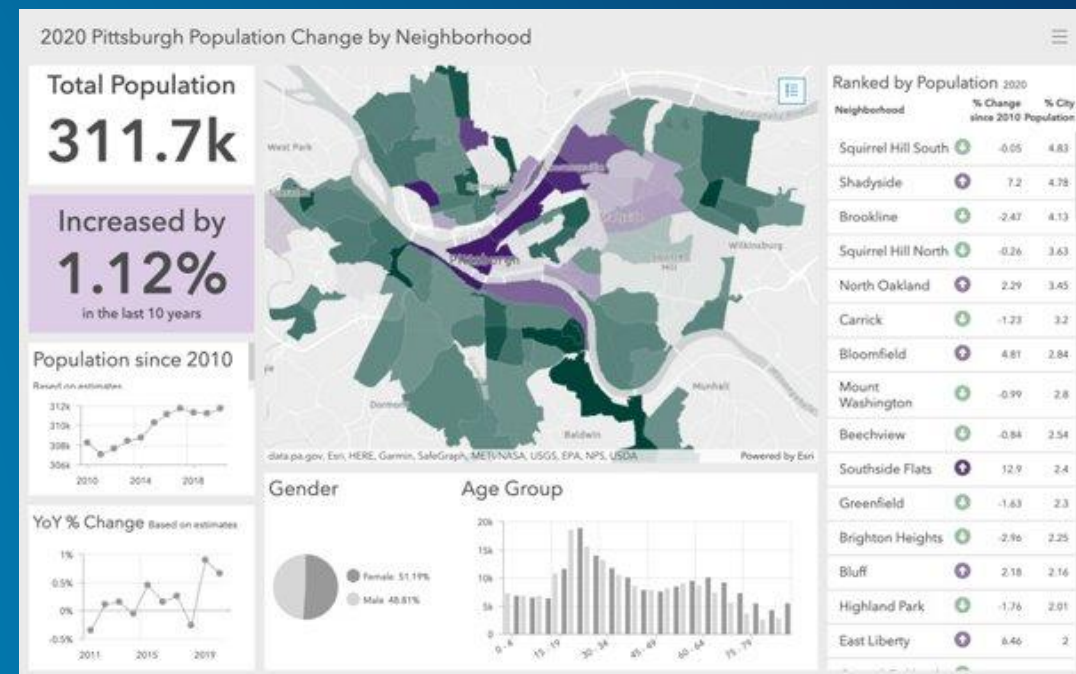
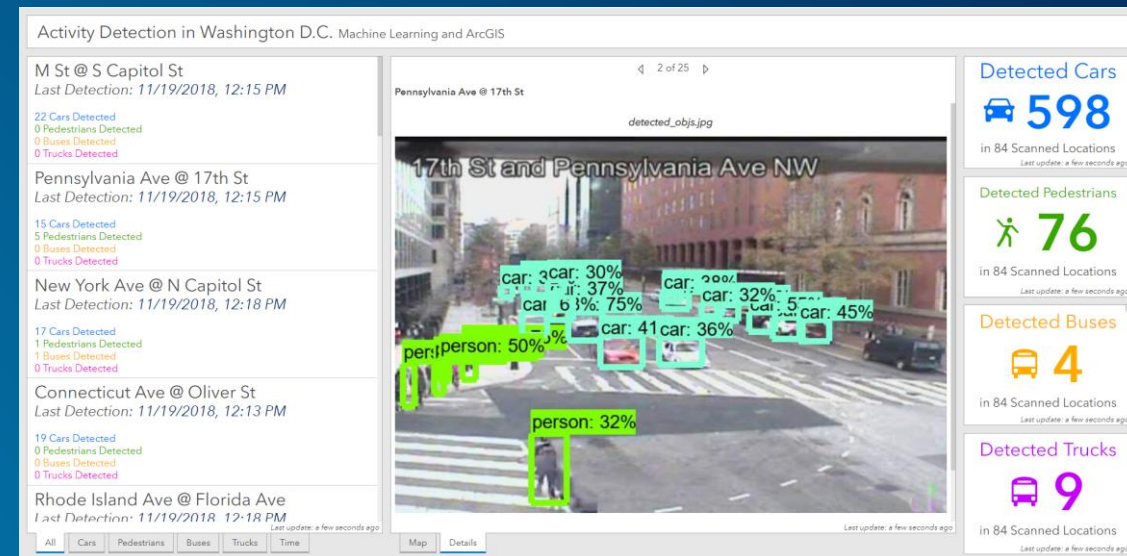
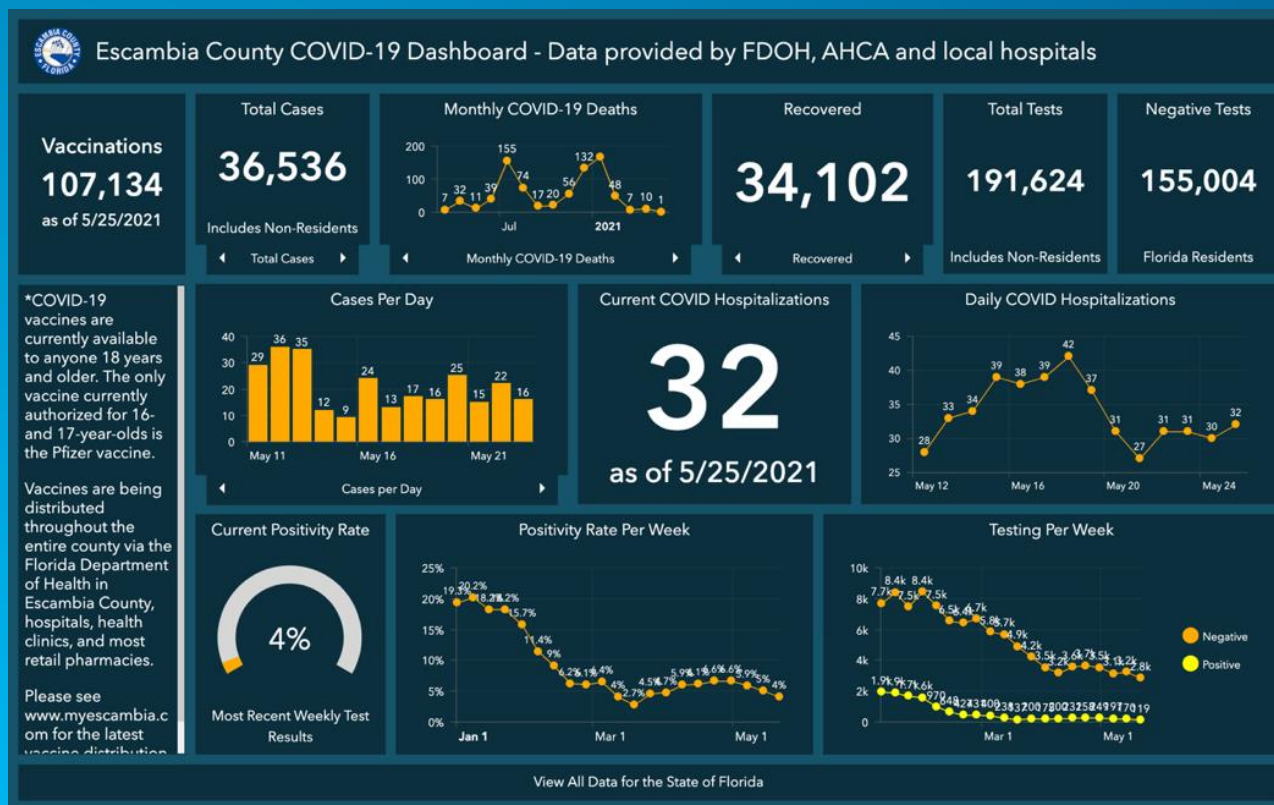
ArcGIS API for JavaScript

ArcGIS WebApp Builder



ArcGIS Dashboard

- Grabs your attention to where it's needed
- Communicates information at-a-glance
- Make it easy to spot what's most important



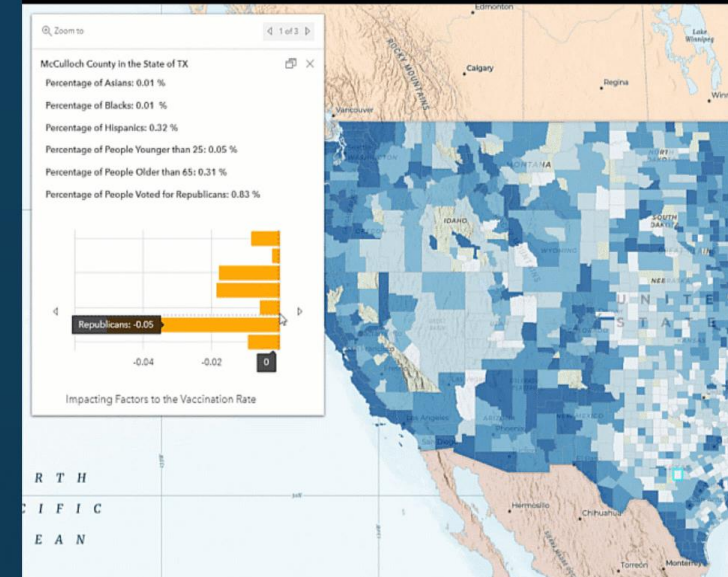
Storytelling

- Turn sophisticated analysis into compelling stories
- Combine interactive maps and multimedia content and text
- Share your narratives with colleagues, clients, and the public.

What Determines Vaccination Hesitance

Identify and quantify impact factors to explain different COVID-19 vaccination rates in the US counties

Carsten Lange and Jian Lange | June 16, 2021



[Introduction](#)

[Interactive Map](#)

[Data](#)

[Methodology](#)

[Key Findings](#)

Introduction

After almost a year of COVID-19 pandemic, the U.S. Food and Drug Administration (FDA) authorized three COVID-19 vaccines. Since the beginning of this year, the US government has started an aggressive vaccination campaign. As of June 2021, 175 million of Americans older than age 12 are vaccinated. The US is finally at a better position to protect its people against the coronavirus.

While the vaccination rates are increasing steadily in the country, not all subgroups in the US population are enthusiastic about the COVID-19 vaccine. Vaccine hesitancy is not a new phenomenon in the US and it had been suggested that age, political affiliation, income etc. may all play a role. In addition, racial and income disparities had also been observed in the uptake of COVID-19 vaccines in the US. In order to assist the policy makers to develop better strategies to

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